

Open biopsy with posterior instrumentation followed by anterolateral approach for removal of an uncommon tumor in the cervical spine

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ABSTRACT

The conventional treatment for the resection of cervical spinal tumors comprises anterior, posterior, and combined surgical approaches. However, these approaches have certain limitations when tumors invade the vertebrae, vertebral artery, or spinal nerves. Herein, we report an interesting case where a 45-year-old patient was admitted for neck pain. An invasive cervical spinal tumor was discovered and approached in two stages: stage 1 was open biopsy with posterior instrumentation, which was followed by stage 2 with an anterolateral approach for definitive surgical resection. A series of preoperative tests including angiography as well as a balloon occlusion test of the vertebral artery facilitated stage 2 surgical planning for gross total resection of the tumor while minimizing surgical complications.

KEYWORDS Anterolateral approach; cervical spinal tumor; invasive lesions; vertebral artery

Spinal tumors are mainly classified into two types: primary tumors deriving from the spine and its adjacent structures and secondary/metastatic tumors originating from distant organs. Mainly from the liver or lungs, metastatic tumors are the most common tumors of the spine, and they tend to involve the thoracic and lumbar areas.^{1,2} It is less common to see patients with metastatic tumors in the cervical spine.³ Based on the surgical strategy developed by Tomita,⁴ common surgical approaches for spinal tumors include the anterior, posterior, and combined approaches. Cervical spinal tumor resection through an anterolateral approach has rarely been reported. We present a case in which an invasive left posterior C2–C4 spinal tumor was successfully resected via the anterolateral approach with an excellent outcome.

CASE DESCRIPTION

A 45-year-old man with no major past medical history was referred to our neurosurgery department for left-sided

posterior neck pain for several days. Neurological examination was remarkable only for mild weakness of the intrinsic muscles in his left hand. Cervical spine computed tomography (CT) and magnetic resonance imaging (MRI) revealed a left cervical epidural mass spanning the C2–C4 levels, extending to the paraspinal muscles, and eroding parts of the C2–C4 vertebral bodies, C2–C5 nerve roots, and left C3–C4 transverse processes, causing enlargement of the transverse foramina (*Figure 1a–1c*). Cervical spine CT angiography showed a patent dominant left vertebral artery (VA). A neoplasm was suspected, and an open biopsy and posterior cervical fusion from C2–C5 was performed (*Figure 1d*). However, the initial pathological diagnosis was inconclusive (*Figure 1e*). The patient then underwent diagnostic cerebral angiography with a balloon occlusion test of the left VA, which showed stable intraoperative electroencephalographic monitoring, indicating sufficient contralateral VA perfusion (*Figure 1f*). Based on these studies, we planned a second and

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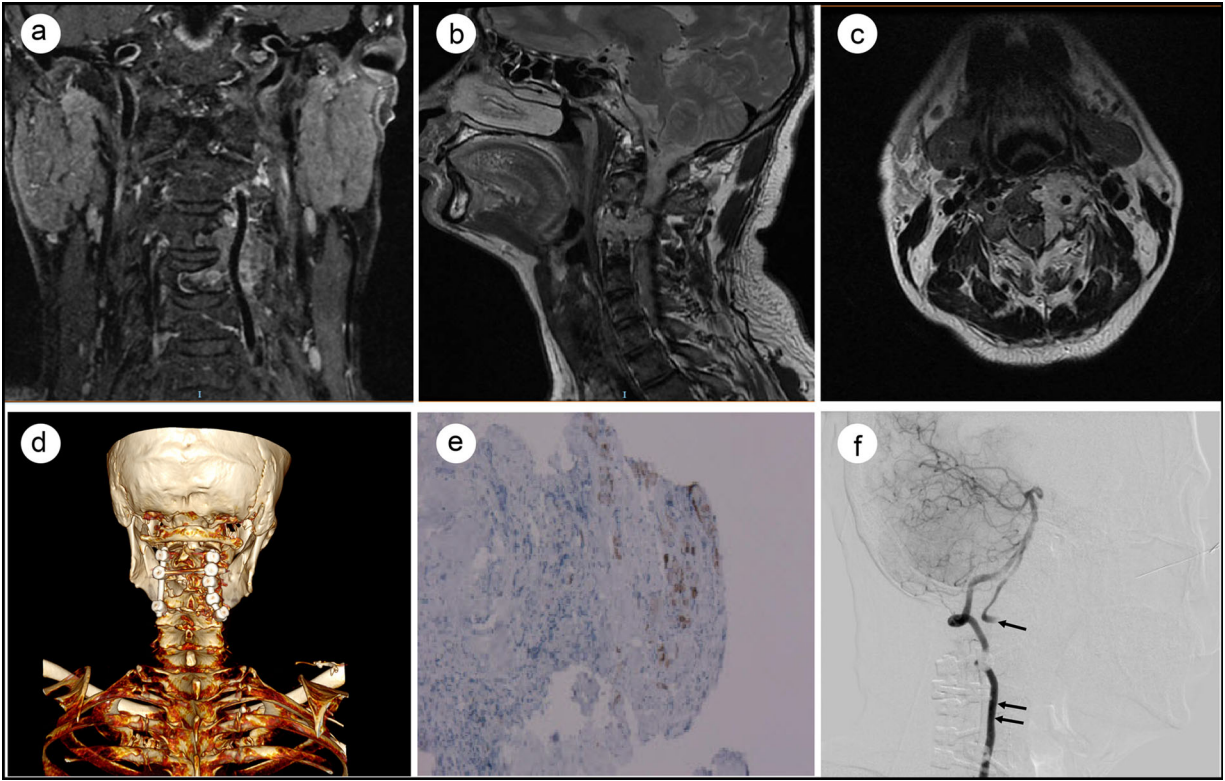


Figure 1. (a) Coronal, (b) sagittal, and (c) axial preoperative MRI images of the tumor. (d) The instrumentations from C2–C5 during the first biopsy procedure. (e) Histopathological staining of the tumor. (f) Balloon occlusion test: right vertebral artery (double arrows) injection presented excellent visualization of the posterior circulation with retrograde flow to the left vertebral artery distal to the balloon occluded segment (arrow).

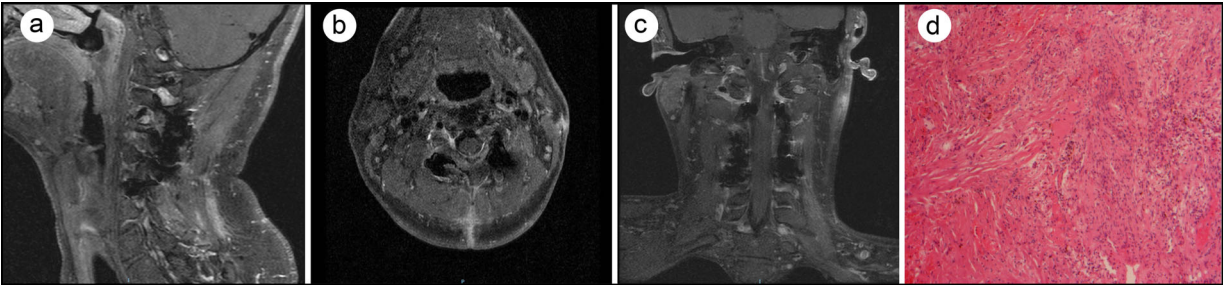


Figure 2. (a) Sagittal, (b) axial, and (c) coronal MRI images 4 months after surgery. (d) Histopathological staining of the tumor.

definitive surgery using the anterolateral approach for gross total resection of the tumor. Intraoperatively, the left VA could not be preserved due to extensive tumor invasion and had to be ligated for complete tumor resection. The left C5 nerve root also had to be transected for tumor resection and was reconnected. Postoperative MRI confirmed gross total resection of the tumor (*Figure 2a–2c*). The final pathological diagnosis was desmoid tumor (*Figure 2d*). Clinically, the patient's neurological examination remained stable; new 3/5 left deltoid muscle weakness improved to 4+/5 at 6-month clinic follow-up.

DISCUSSION

When the vertebral bodies, VAs, and cervical nerves are all invaded by a spinal tumor, surgical resection can be difficult, necessitating multidisciplinary collaboration.⁵ In our

case, preoperative imaging suggested multilevel vertebral body erosion and destruction, leading to instability of the spinal column. Therefore, a posterior C2–C5 instrumented fusion was first performed for spinal stabilization. With paravertebral tumor invading the nerve roots and encasing the VA, a conventional anterior cervical spine approach is inadequate for tumor exposure.⁶ Jules-Elysee suggested that anterior surgery could cause respiratory complications and esophageal injury.⁷ Posterior resection of paravertebral tumors requires an exposure of sufficient surgical field, and total resection would be impossible to complete as the tumor blocks the view. Although the combined anterior and posterior approach increases the chance of total tumor resection, its morbidity and the possibility of tumor spread need to be considered as well.^{8,9} The anterolateral approach can be used to remove tumors from the intervertebral foramina, laminae,

and transverse processes. However, this approach may injure the ipsilateral VA and adjacent cervical nerves. Therefore, it is crucial to evaluate the vasculatures prior to the operation and protect the cervical nerves during the operation.

In spinal tumor cases with VA involvement, the decision of whether to sacrifice it must be carefully investigated, and one of the methods is a balloon occlusion test.¹⁰ This question was especially important in our case, since the left VA appeared to be the dominant supplier of the posterior circulation. Fortunately, electroencephalographic findings during a balloon occlusion test of the left VA were stable and the patient recovered well after left VA ligation.

With no residual tumor on postoperative MRI and a low proliferation rate, radiotherapy and chemotherapy were held off after the operation. The early detection and definitive surgical treatment prevented further destructive effects of the lesion, and the patient returned to his daily routines 1 month after the operation.

In conclusion, for cervical spine tumors that invade the vertebral bodies, transverse foramina, spinal canal, and paraspinous muscles, the two-stage approach including posterior stabilization and anterolateral tumor resection is extremely helpful to achieve a gross total resection. In cases with VA involvement, a balloon occlusion test is a useful adjunct to decide if it can be safely ligated.

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1. Kelley SP, Ashford RU, Rao AS, et al. Primary bone tumours of the spine: a 42-year survey from the Leeds Regional Bone Tumour

- Registry. *Eur Spine J.* 2007;16(3):405–409. doi:[10.1007/s00586-006-0188-7](https://doi.org/10.1007/s00586-006-0188-7).
2. Maddams J, Brewster D, Gavin A, et al. Cancer prevalence in the United Kingdom: estimates for 2008. *Br J Cancer.* 2009;101(3):541–547. doi:[10.1038/sj.bjc.6605148](https://doi.org/10.1038/sj.bjc.6605148).
3. Ciftedemir M, Kaya M, Selcuk E, et al. Tumors of the spine. *World J Orthop.* 2016;7(2):109–116. doi:[10.5312/wjo.v7.i2.109](https://doi.org/10.5312/wjo.v7.i2.109).
4. Tomita K, Kawahara N, Kobayashi T, et al. Surgical strategy for spinal metastases. *Spine (Phila Pa 1976).* 2001;26(3):298–306. doi:[10.1097/00007632-200102010-00016](https://doi.org/10.1097/00007632-200102010-00016).
5. Groenen KH, van der Linden YM, Brouwer T, et al. The Dutch national guideline on metastases and hematological malignancies localized within the spine; a multidisciplinary collaboration towards timely and proactive management. *Cancer Treat Rev.* 2018;69:29–38. doi:[10.1016/j.ctrv.2018.05.013](https://doi.org/10.1016/j.ctrv.2018.05.013).
6. Mazel C, Balabaud L, Bennis S, et al. Cervical and thoracic spine tumor management: surgical indications, techniques, and outcomes. *Orthop Clin North Am.* 2009;40(1):75–92. doi:[10.1016/j.ocl.2008.09.008](https://doi.org/10.1016/j.ocl.2008.09.008).
7. Jules-Elysee K, Urban MK, Urquhart BL, et al. Pulmonary complications in anterior-posterior thoracic lumbar fusions. *Spine J.* 2004;4(3):312–316. doi:[10.1016/j.spinee.2003.11.008](https://doi.org/10.1016/j.spinee.2003.11.008).
8. Abe E, Kobayashi T, Murai H, et al. Total spondylectomy for primary malignant, aggressive benign, and solitary metastatic bone tumors of the thoracolumbar spine. *J Spinal Disord.* 2001;14(3):237–246. doi:[10.1097/00002517-200106000-00009](https://doi.org/10.1097/00002517-200106000-00009).
9. Krepler P, Windhager R, Bretschneider W, et al. Total vertebrectomy for primary malignant tumours of the spine. *J Bone Joint Surg Br.* 2002;84(5):712–715. doi:[10.1302/0301-620x.84b5.12684](https://doi.org/10.1302/0301-620x.84b5.12684).
10. Ogunbemi A, Elwell V, Choi D, et al. Permanent endovascular balloon occlusion of the vertebral artery as an adjunct to the surgical resection of selected cervical spine tumors: a single center experience. *Interv Neuroradiol.* 2015;21(4):532–537. doi:[10.1177/1591019915590072](https://doi.org/10.1177/1591019915590072).